0·1; $K_2HPO_4$, 0·05; $MgSO_4.7H_2O$, 0·08; NaCl, 0·02; $FeCl_3$, 0·001 and agar, 2·0; pH adjusted to 7·2. Each isolate was inoculated to petri plates by depositing a mass of bacterial cells with a loop in the centre of the petri plates as done by earlier workers[1-2]. The plates were incubated for 10 days at 28° C followed by flooding the plates with Benedict's reagent for sixty minutes at room temperature. Simultaneously, nodulation tests were done in sand culture in pots and on agar slopes in test tubes[3-4].

TABLE I

*3 ketolactose production and nodulation tests by nodule bacteria*

| Bacterial isolates from nodules | Number of isolates | | |
|---|---|---|---|
| | Tested | 3-keto-lactose negative | 3-keto-lactose positive |
| *Cicer arietinum* | | | |
| Nodulating isolates | 114 | 114 | Nil |
| Non-nodulating isolates | 16 | 11 | 5 |
| *Sesbania bispinosa* | | | |
| Nodulating isolates | 12 | 12 | Nil |
| Non-nodulating isclates | 4 | 1 | 3 |

The results (Table I) confirm the earlier observations that *Rhizobium* is negative to ketolactose test. However, it was also observed that some isolates which were positive to ketolactose test could not nodulate the roots of host plants. Nevertheless, some of the non-nodulating isolates, which grew incidentally faster than the nodulating ones on this medium, were found to be ketolactose negative whose identity could not be made out by applying the present test. Therefore, the ketolactose test may be useful in helping to distinguish agrobacteria from rhizobia for routine screening but the final proof for the identity of *Rhizobium* must rest with its ability to form nodules on roots of homologous hosts.

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## IS *ACROSTICHUM AUREUM* L. TRULY A MANGROVE FERN?

ALTHOUGH most of the plants of Indian shores are more or less known relatively little attempt seems to have been made so far to evaluate their niche, breadth, and overlap along the shore or the plant communities into which they are grouped in relation to ecological factors. The data, accrued on these aspects, would be of considerable help for a better understanding of their exact ecological status.

*Acrostichum aureum* is a pantropical gregariously growing coastal fern on landward mangrove swamps, or sea fronted strand areas in the absence of mangroves, or salt water creeks, or on wet lands which have been cut off from the sea. The occurrence of this fern is recorded throughout the Malayan archipelago, Philippines and also in the Andaman and the Nicobar group of islands in association with Nypa formation. In Malaya[1] it abundantly occurs in brackish water swamps up to 700 m from the sea level and in Philippines[4] on salty hot springs. While describing the ecology of ferns of Singapore island[2] it is observed that this fern although it cannot stand too much salty water is conspicuously found towards the landward side and also on raised bunds in mangrove regions. In India the growth of this fern is seen on the tidal estuarine river banks of Sunderbans of the Gangetic delta in West Bengal, the estuarine complex in between the Devi and the Dhamra rivers of the Cuttack District in Orissa State and along the Kerala and Mysore coasts up to Karwar, which represents its north-western limit of extension[5-7]. Thus, its distribution coincides only with the subhumid or perhumid areas of the coast of this subcontinent.

During collection of this fern in India it was noticed that this plant rarely extends into the inland areas. However, its growth in freshwater river banks of Kerala, especially along the banks of Muvathupuzha river in between Vaikom and Kottayam, was observed (N. C. Nair 40296, 40721 CAL). Its inland occurrence is reported from Africa[3] and Malayan archipelago[1]. Recently, this fern was found growing in patches on the exposed sea in front of the Varkala cliffs in the Kerala State. Thus it is evident that this fern, while characteristic of outward mangrove habitat, grows on a varied range of habitats including freshwater sources, saline creeks, swampy estuarine borders[6] and elevated sandy areas. Hence it was thought worthwhile to examine the soil where this fern occurs to evaluate its exact ecological status.

Soil samples were collected from different places and their analyses are shown in Table I. The

TABLE I

| Sample No. | Location | Depth in cm | Vegetation cover | Mechanical analysis: Clay % | Silt % | Fine sand % | Coarse sand % | Soil texture | pH | Organic matter % | T.S.S. % | NaCl % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| K 6 | Ashtamudi-lagoon island (Kerala) | 0·15 | *Acrostichum aureum* | 8·95 | 3·80 | 79·97 | 7·28 | Loamy sand | 6·8 | 2·03 | 0·225 | 0·0585 |
| K 10 | Verkala laterite : supra-littoral zone (Kerala) | 0·15 | do. | 15·50 | 9·80 | 24·71 | 49·99 | Sandy loam | 5·5 | 6·16 | 0·725 | 0·0585 |
| K 11 | do. Elevated sandy zone (Kerala) | 0·15 | do. | 29·50 | 6·20 | 20·57 | 43·73 | Sandy clay | 6·0 | 0·44 | 0·190 | 0·049 |
| K 20 | Veli lagoon (Kerala) | 0·15 | do. | 15·80 | 10·40 | 24·30 | 49·50 | Sandy loam | 5·6 | 6·35 | 2·725 | 1·8720 |
| K 21 | do. | 0·15 | do. | 9·40 | 3·40 | 0·90 | 86·30 | Loamy sand | 6·0 | 0·51 | 0·075 | 0·0293 |

mechanical analyses of the soil samples indicate that the clay fraction ranges from 8·9% to 29·50%, pH from 5·5 to 6·8, organic matter 0·15% to 6·35%, salinity from 0·190% to 2·725% and sodium chloride from 0·0293% to 1·8720%. From this data it is very clear that this fern grows gregariously on loamy sand or sandy clay with sufficient percentage of clay, rich in organic matter percentage and a pH of acidic to neutral value. The varied percentages of sodium chloride and total soluble salts clearly indicate its salt tolerant capacity. The pH value reflects that this fern does not favour mangrove alkaline habitat and any further progressive growth is due to changes from an alkaline habitat to acidic habitat. The explanation is that the increased accumulation of organic matter leads to the formation of sufficient organic acid to neutralise the alkaline habitat. Furthermore, the habitat becomes strongly acidic if the area is not inundated by saline water. Undoubtedly this fern tolerates moderate salinity and chloride contents as evidenced by its vigorous growth in slightly brackish water or in coastal niches which receive heavy rainfall. The analyses of water samples for sodium chloride and pH from different places of Malaya[1], where the fern was found growing very well, showed sour but not salty and normal sweet water to sweet water of acidic value.

It is thus clear that this fern is mainly characteristic in the vicinity of mangrove areas and also infrequently grows on varied habitats under conditions of saturated water supply. Further, it is seen that changes from alkaline to acidic condition due to autogenic or biotic causes pave a way for the invasion and spread of this weed into the mangrove zone. The apparent association of this fern with mangroves has led to the belief that it is a mangrove fern. A comparative study of the underlying soils shows that it is a freshwater salt tolerant fern growing gregariously over a clayey substratum rich in organic matter and a pH of acidic value. Furthermore, differences in the population of this fern are predictable to the setting up of secondary conditions in the sensitive mangrove ecosystem.

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